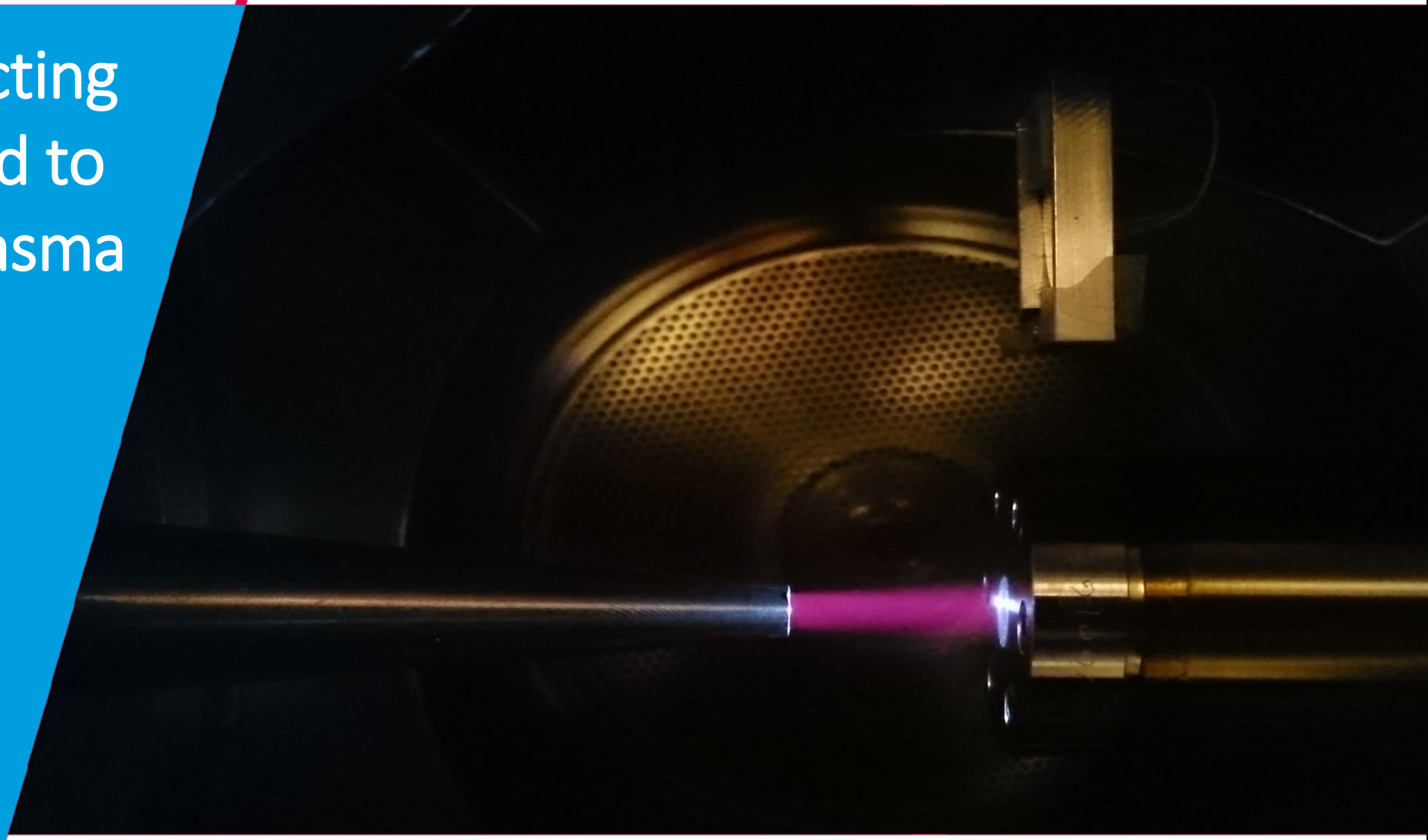
Technische Universiteit
Eindhoven
University of Technology

Ion Fluxes Impacting Surfaces Exposed to EUV-Induced Plasma



Tijn van de Ven

Ruud van der Horst

Kees de Meijere

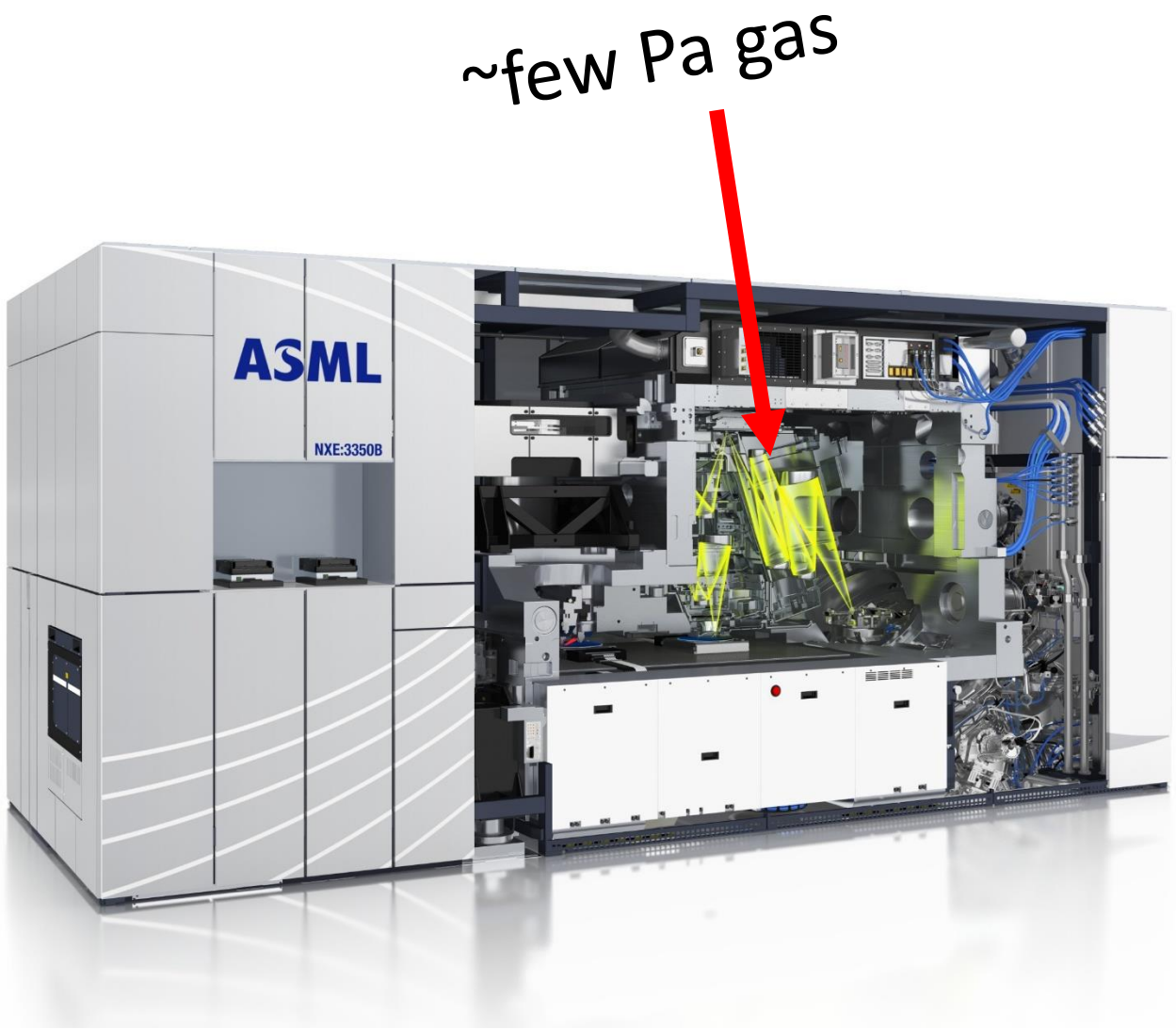
Maarten van Kampen

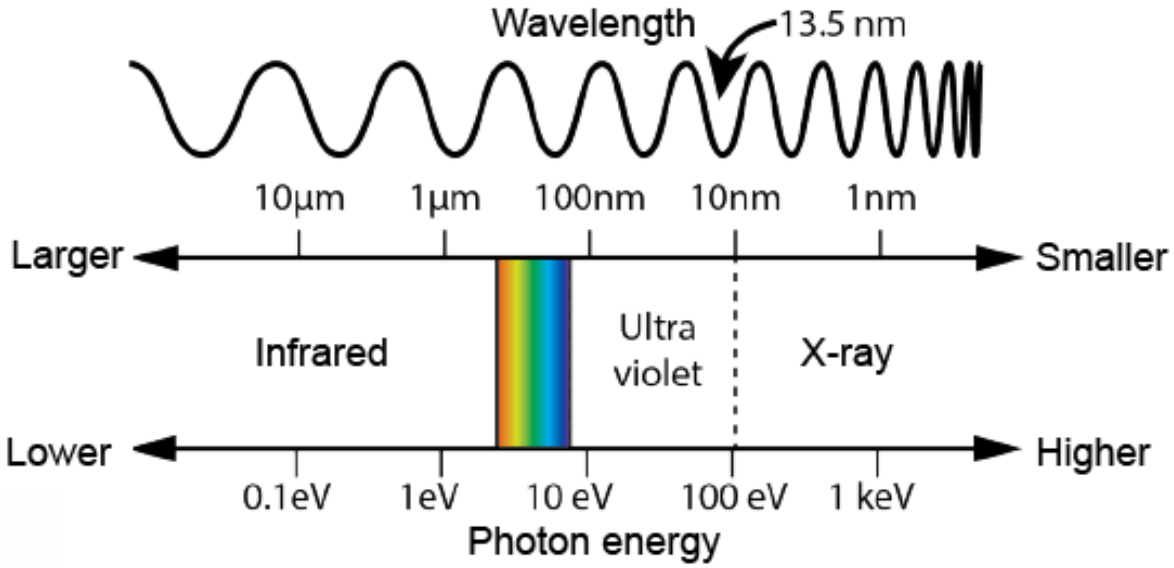
Vadim Banine

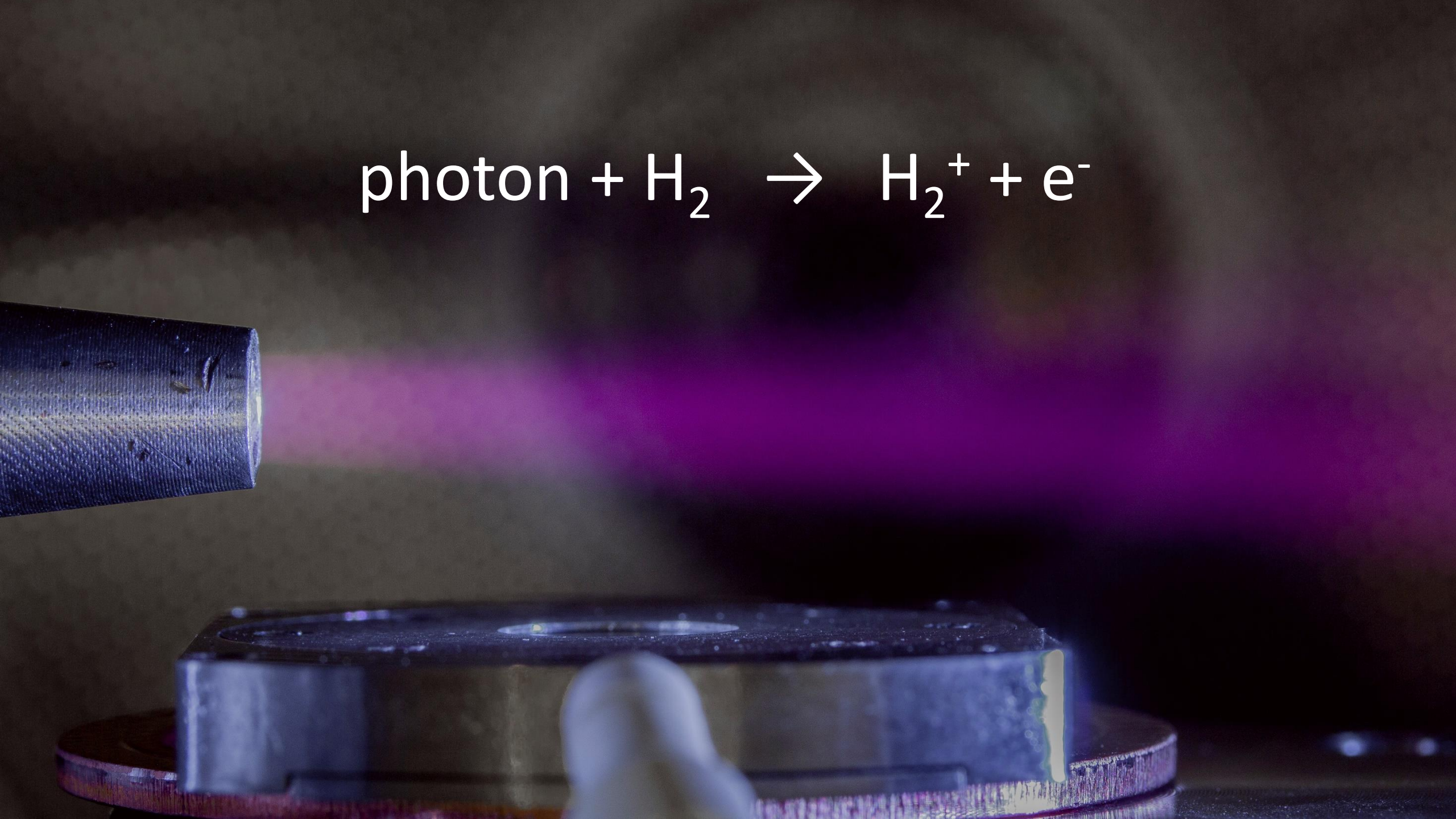
Job Beckers

Where innovation starts

ASML


~few Pa gas
ASML
NXE:3350B

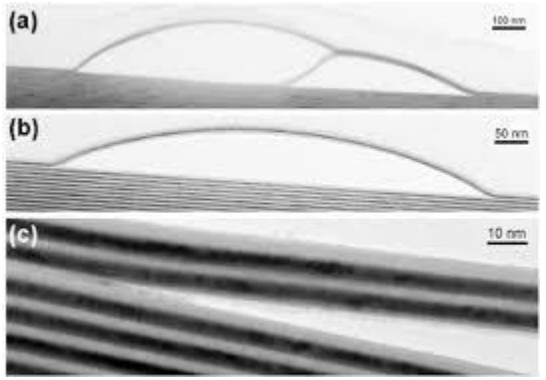

Wavelength
13.5 nm
10µm
1µm
100nm
10nm
1nm
Larger
Smaller
Infrared
Ultra violet
X-ray
Lower
Higher
0.1eV
1eV
10 eV
100 eV
1 keV
Photon energy

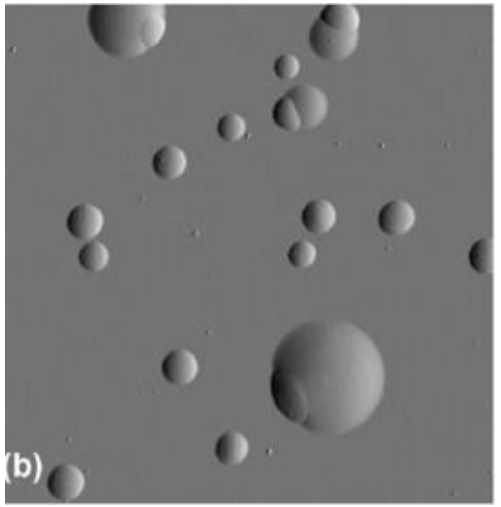

photon + H_2 → $H_2^+ + e^-$

EUV + gas → plasma







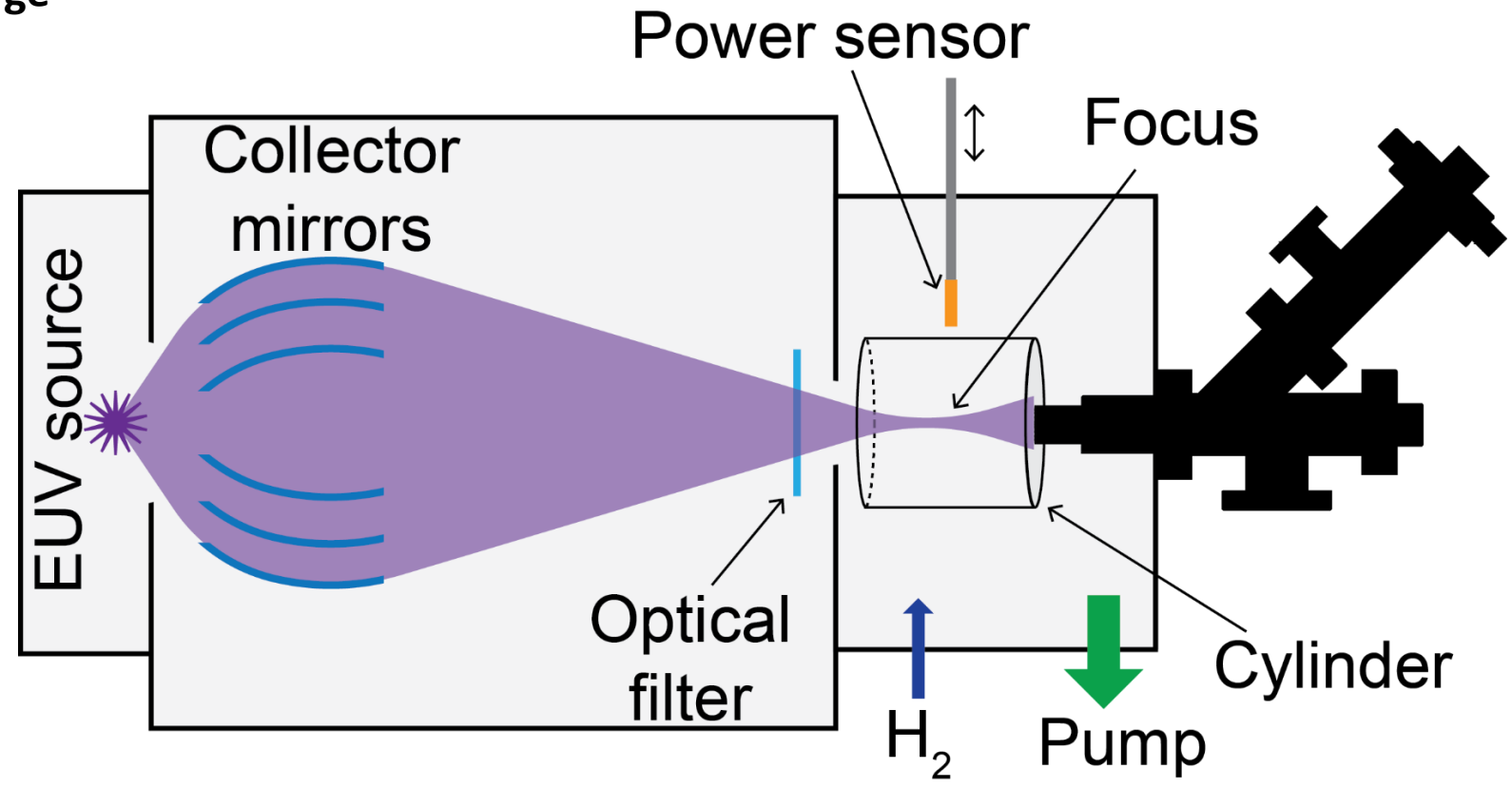


NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

A S Kuznetsov, M A Gleeson and F Bijkerk, *J PHYS-CONDENS MAT* (24) 5, 2011

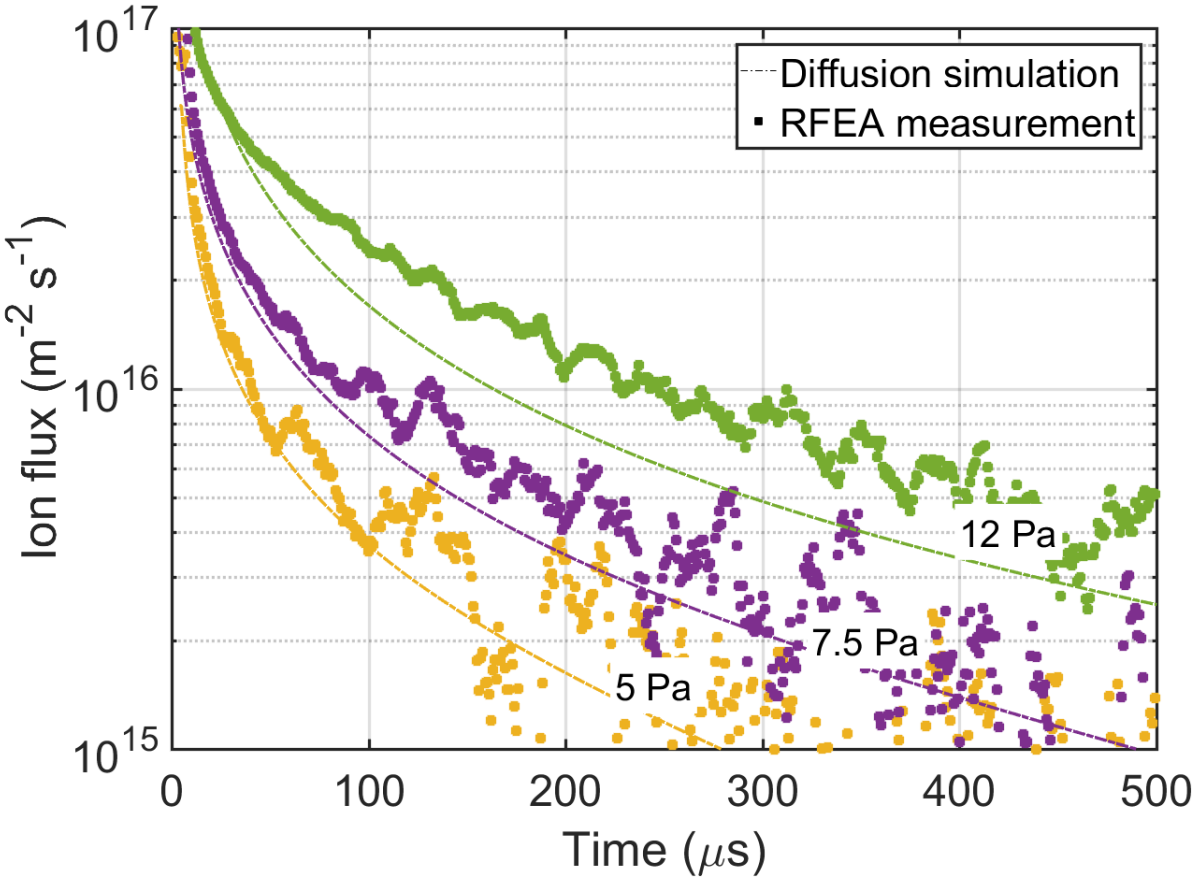
Characterize the ion fluxes towards surfaces exposed to EUV-induced plasma

Hollow cathode
Xe pinch discharge
500 Hz
150 µJ/pulse



Ion mass spectrometer *or* RFEA

Evolution of the ion-flux density

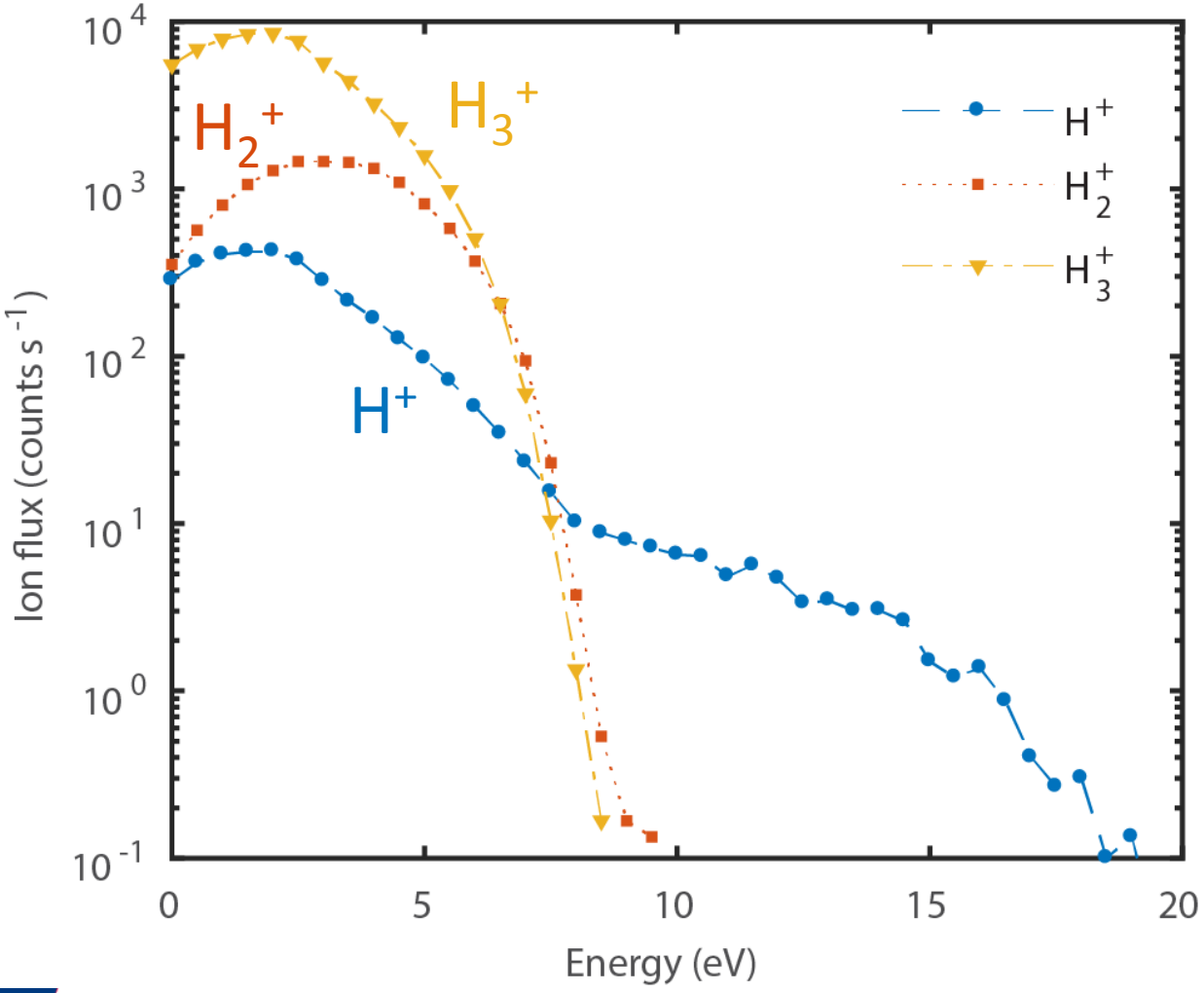


The temporal evolution of the ion-flux density can be described using classic plasma physical concepts

RnD ISAN Simulations

EPG Experiments

Ion-flux composition and energy distribution



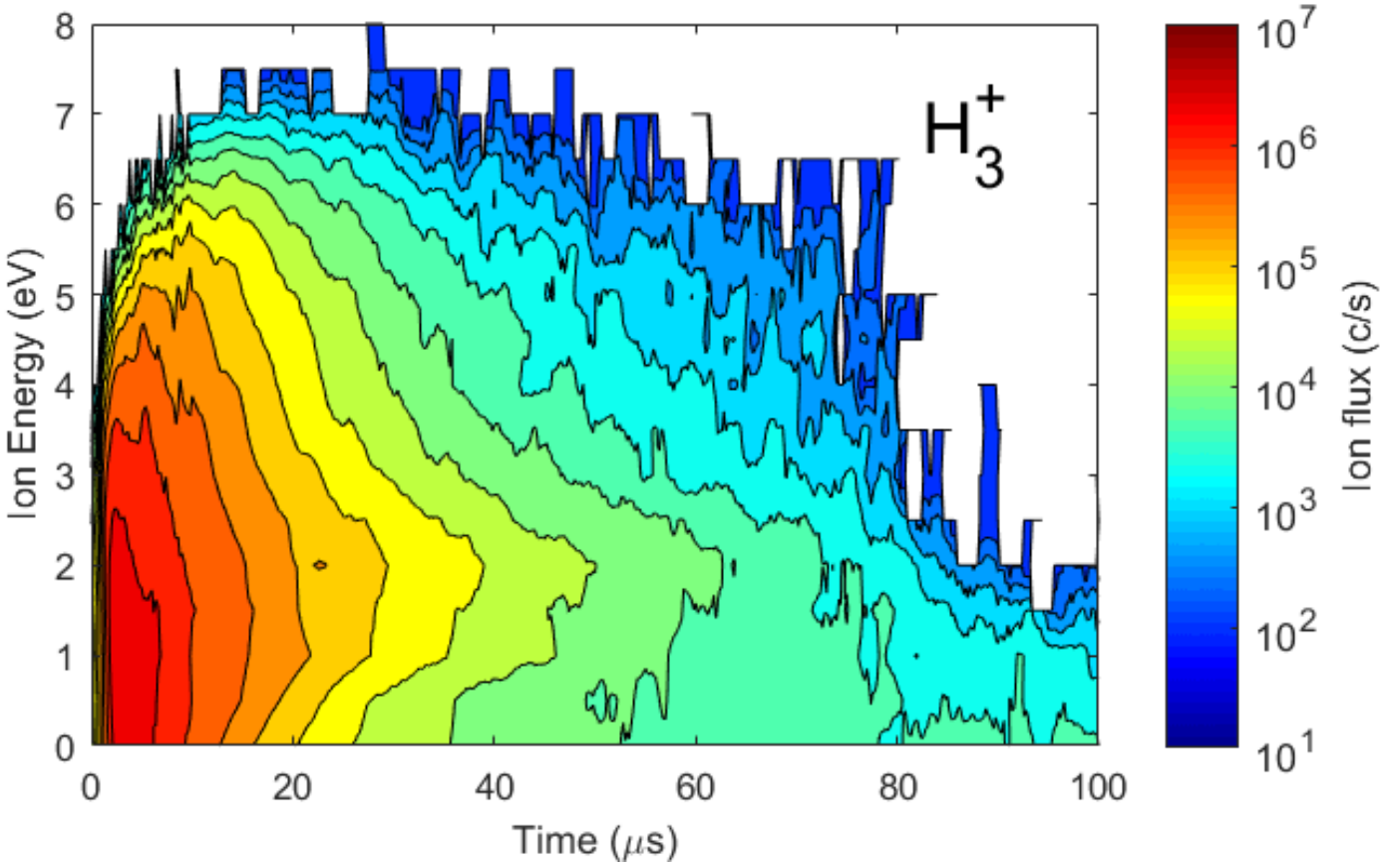
H_3^+ is most abundant

Ion energies are low (<10 eV)

Energy distribution of H^+ has a high-energy tail

T.H.M. van de Ven, P. Reefman, C.A. de Meijere, R.M. van der Horst, M. van Kampen, V.Y. Banine and J. Beckers, Ion energy distributions in highly transient EUV induced plasma in hydrogen, Journal of Applied Physics, 123(7), 2018

Evolution of the ion energy distribution

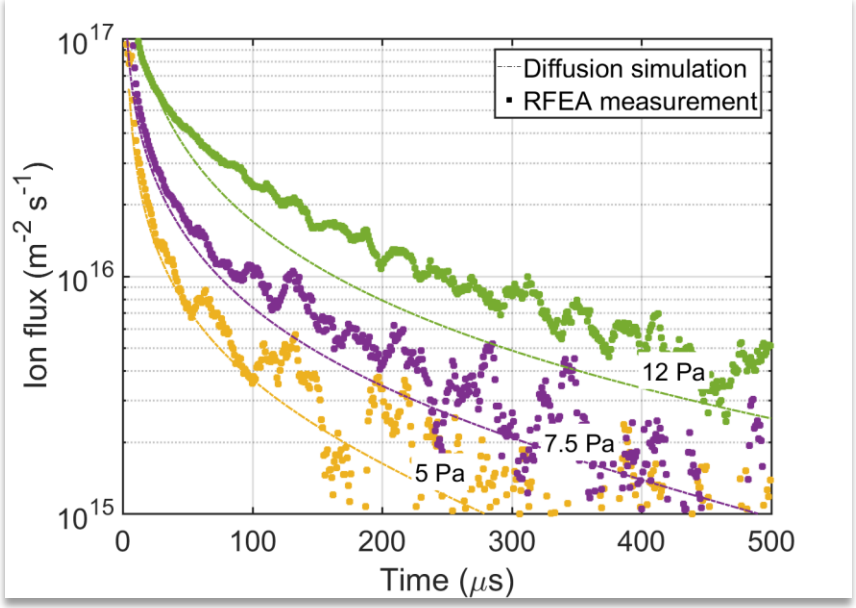


Plasma remains ‘hot’ for longer than expected

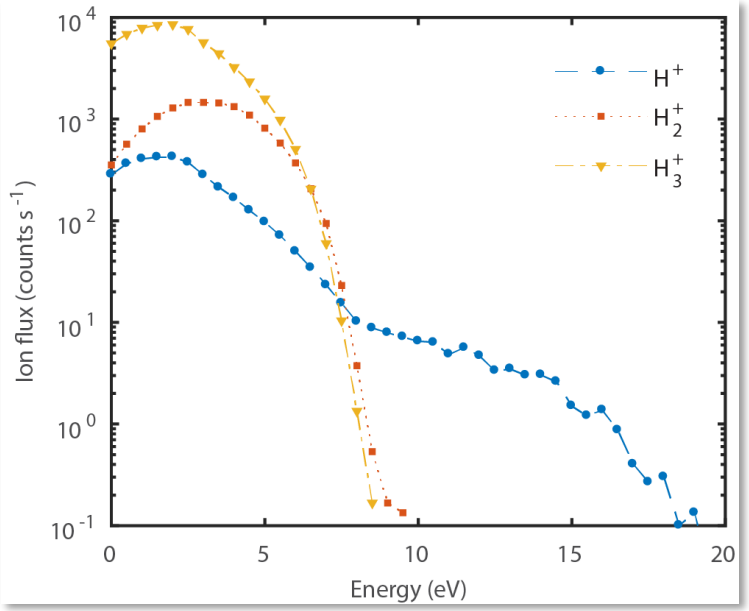
Possible explanation:

Superelastic collisions electrons and vibrationally excited H_2

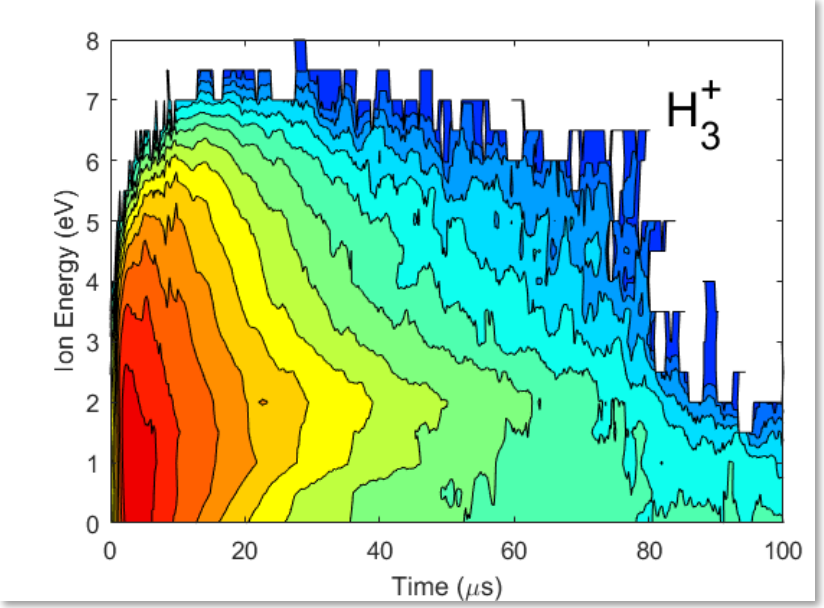
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Ion fluence can be modeled



H^+ energetic tail



Plasma remains ‘hot’

Technische Universiteit Eindhoven University of Technology

ASML

Elementary Processes in Gas discharges



Wim van der Zande



Maarten van Kampen



Kees de Meijere



Ruud van der Horst

Vadim Banine



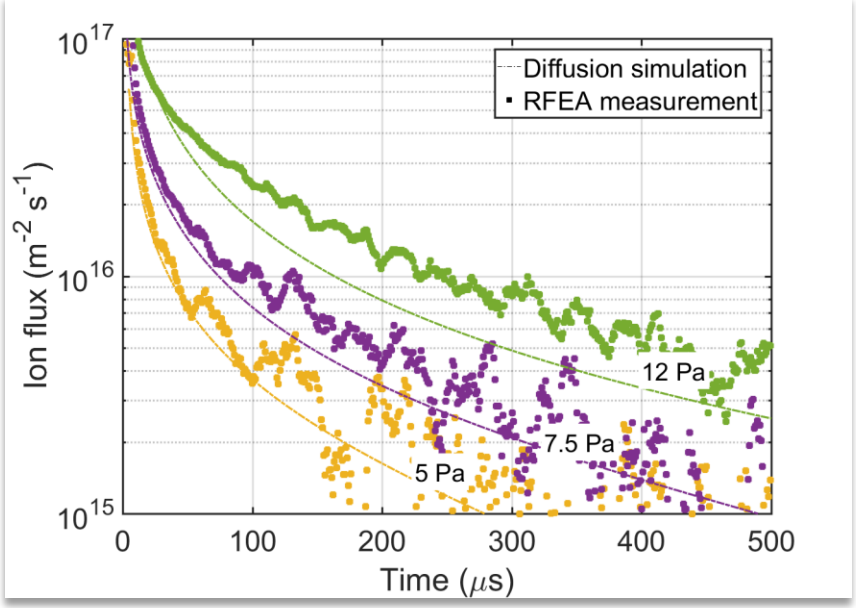
Job Beckers



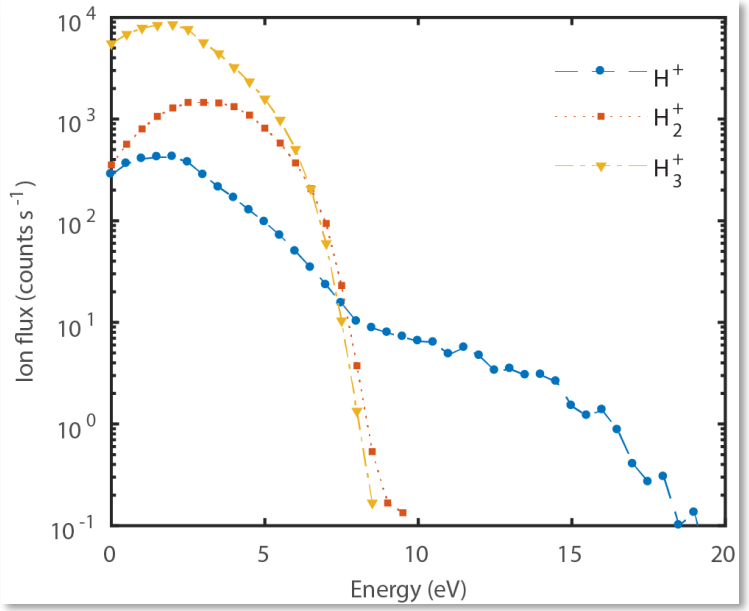
Thesis online:
https://pure.tue.nl/ws/files/98728540/20180704_van_de_Ven.pdf

Or via Linkedin:
https://www.linkedin.com/in/tijnvandeven/

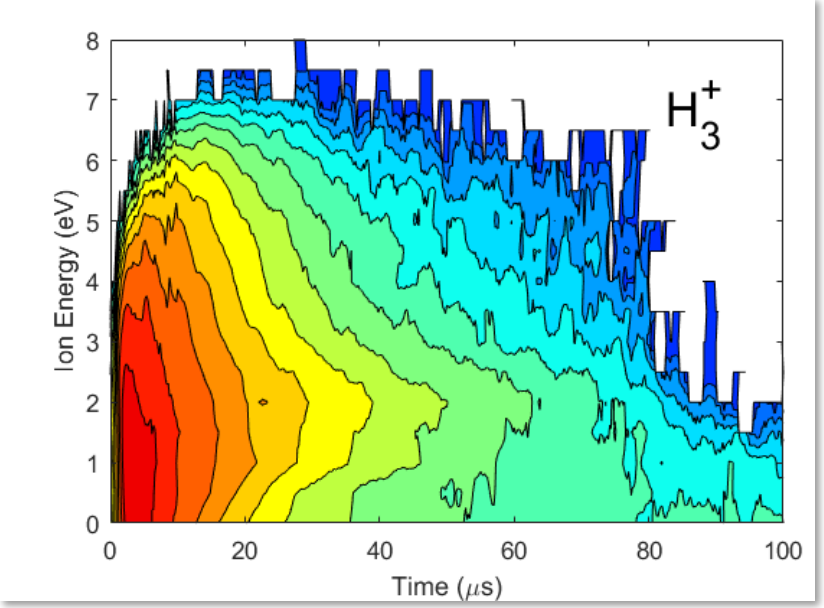
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